

CLAY BRICK MASONRY HIGH LIFT GROUTING METHOD

IR 21-3

Reference: California Building Code, Section 2104A.6

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This interpretation is intended for use by the plan review and field engineers of DSA to indicate an acceptable method for achieving compliance with applicable codes and regulations. Its purpose is to promote more uniform statewide criteria for use in plan review and supervision of construction of public schools, community colleges and essential services buildings. Other methods proposed by design professionals to solve a particular problem may be considered by DSA and reviewed for code and regulation compliance.

Purpose: The purpose of this IR is to provide the requirements and procedure for high lift clay brick masonry grouting when the use of this method is approved by the Division of the State Architect (DSA).

1. Description. The high lift grouting method has been developed for use on wall construction consisting of two wythes of brick masonry bonded to a grout core which contains the vertical and horizontal reinforcing. The wythes are connected by wire ties laid in the mortar joints at a spacing adequate to resist the hydrostatic pressure of the fluid grout during the pouring operation.

Use of this method should be restricted to walls where openings, arrangement of piers, special reinforcing details, or embedded items do not prevent the free flow of grout or inhibit the use of mechanical vibration to properly consolidate the grout core. Horizontal reinforcing or embedded items such as structural connections or electrical conduit should be positioned so as to allow maximum accessibility to the grout space.

The procedure requires that all masonry units, reinforcing steel and embedded items are in place before grouting of the wall commences. Arrange the work so that once the grouting of a section of wall is started, the grouting proceeds in lifts without stopping except as noted below, until the full height of the prepared section is poured. The waiting period between lifts is limited to the time required to obtain an initial consolidation of grout due to settlement, shrinkage and absorption of excess water by the masonry units. The waiting period reduces the hydrostatic pressure of the grout on the masonry wythes and reduces the possibility of "blow-outs."

The grout is to be a workable mix, preferably placed by pumping, to permit continuous pouring and is to be worked into all voids with mechanical vibrators. Because of the high water/cement ratio used in this type of grout, it is essential that the grout be reconsolidated after it has taken on a plastic consistency, but prior to taking an initial set. The reconsolidation is intended to overcome settlement shrinkage, separations from the reinforcing steel and to promote bonding to the masonry unit walls.

For the purpose of this IR, a "pour" is considered as the entire height of grout fill placed in one day and is composed of a number of successively placed grout lifts. A "lift" is the layer of grout placed in a single continuous operation.

The maximum height of pour is limited by the practical considerations of segregation of grout due to the height of free fall, effect of dry grout deposits left on the bonding face of the masonry units and reinforcing steel and the ability to effectively reconsolidate the grout. Unless specifically approved otherwise, the maximum height of pour is sixteen feet for walls with a single curtain of reinforcing steel (less than 12" thick) and twenty feet for walls with two curtains of reinforcement (12" or more in thickness). The minimum grout space width is 3 ½" and the wall shall be constructed so as to preserve an unobstructed vertical alignment of the grout space.

2. Quality of Materials. All materials are to conform to CBC, Section 2102A with the following additional requirements:

1. Pea Gravel. Pea gravel for grout is to conform to ASTM C404 Aggregates for Grout, except when other gradings are specifically approved by the architect or structural engineer and DSA.
2. Coarse Aggregate. Coarse aggregate as for concrete, when permitted in grout fill, is to conform to CBC, Section 1903A.3.
3. Admixture. The grout should contain an admixture of the type that reduces early water loss to the masonry units and produces an expansive action in the plastic grout sufficient to offset initial shrinkage and promote bonding of the grout to all interior surfaces of the masonry units. Obtain the approval of the architect or structural engineer and DSA for use of the admixture.

3. Mortar and Grout.

3.1 Mortar. Mortar is to comply with the requirements of CBC, Section 2103A with the following additional requirements:

1. Place approximately half of the required water and sand into the mixer while running.
2. Add cement and the remainder of the sand and water into the mixer in that order and mix for a period of at least two minutes.
3. Add lime and continue mixing as long as needed to secure a uniform mass.
4. The total mixing time may not be less than 10 minutes.

3.2 Grout. The grout mix is to comply with the requirements of CBC, Section 2103A.4.

Sufficient water may be added to make a workable mix that will flow into all voids in the masonry tiers without separation or segregation. The slump of the grout should be varied depending on the rate of absorption of the masonry units and temperature and humidity conditions. The range should be from eight inches (8") for units with a low rate of absorption (30 to 40 grams per minute) up to ten inches (10") for units with a high rate of absorption (80 to 90 grams per minute).

Grout mixes are to contain an approved admixture conforming to the requirements of Item 2 (3.) above. Use such admixture strictly in accordance with the manufacturer's instructions.

Where the width of the grout space exceeds five inches, grout using a coarser aggregate may be used if the mix is designed in accordance with CBC, Section 1905A. The maximum size aggregate is not to exceed one inch. The water per sack of cement may be greater than is shown in CBC, Table 19A-A-8 to allow for absorption by the masonry units and sufficient workability to meet the requirements given above.

3.3 Mixing of Grout. The mixing of grout is to conform to the requirements for mixing of concrete, CBC, Section 1905A.8. Whenever possible, batch, mix and deliver grout in accordance with the requirements for transit-mixed concrete.

Time the admixture addition in strict accordance with the manufacturer's instructions. The procedure used for adding it to the grout mix should provide for good dispersion.

3.4 Tests. Testing of mortar and grout is to conform to the requirements of CBC, Sections 2105A.3, 2105A.4 and 2105A.5.

4. Construction. The construction of high lift clay brick masonry work is to conform the requirements of CBC, Chapter 21, with the following additional requirements:

1. Wall Make-Up. Lay brick level in two wythes with a separation for grout space not less than 3 ½". The minimum wall thickness is governed otherwise by CBC, Table 21A-R.
2. Foundations. Clean thoroughly and roughen the contact surface of all foundations and floors that are to receive masonry work in accordance with CBC, Section 2906A.4 before start of laying. Protect the roughened surface during construction to assure a good bond between the grout fill and the concrete surface.
3. Cleanouts. Provide cleanout openings for all walls at the bottom of each pour. These openings are to be made by omitting alternate bricks on one wythe of the wall or by forming openings of equivalent size and spacing in the foundation.

After the laying of the masonry units is completed, clean all foreign material from the bottom of the grout space and position the reinforcing steel. Have all preparatory work approved by the inspector, then close the cleanout holes. The holes may be plugged with brick units set in mortar or covered with forms. The brick plugs are to have a two-day minimum curing time or are to be adequately braced to resist the pressure of the fluid grout.

4. Control Barriers. Place vertical barriers or dams to control the extent of the pours horizontally. Such barriers may be formed of brick across the grout space (in full vertical and horizontal joints of mortar) full height of wall. Dams are to be located where designated by the architect or structural engineer.
5. Reinforcement. Place all reinforcing steel accurately in strict accordance with the approved plans and specifications. Both horizontal and vertical reinforcing are to be held in position by wire tie or spacing devices near ends and at intervals not exceeding 192 diameters of the reinforcement. Place the horizontal reinforcing as the work progresses and the vertical reinforcing may be dropped into position after the completion of the laying if adequate positioning devices are provided to hold the threaded reinforcement.
6. Laying Brick. The brick is to be clean and all dust or dirt removed from the surfaces before laying. At the time of laying, all brick is to be damp and have a residual absorption between 5% and 10%. Take special care when using units with different absorption characteristics in the same wall.

Lay the brick in mortar with full shoved bed and head joints. Take care in placing the mortar to keep a minimum of droppings from falling into the grout space. As the work progresses, both of the wythes should be kept approximately at the same height to accommodate the wall ties. Place the ties in the mortar bed and vertically align all ties to facilitate the vibrating of the grout pours.

7. Cleaning the Grout Space. Thoroughly clean all mortar droppings from the construction joint at the foundation and from the reinforcing steel. Remove all mortar projections which extend more than one-quarter inch (1/4") into the grout space.

Recommended methods to maintain a clean horizontal construction joint at the foundation are to cover the exposed foundation surface with a one-to-two inch layer of

sand to receive the mortar debris and, (1) removing mortar from reinforcing steel and mortar projecting into the grout space from the mortar joists by hosing out the grout space at least twice a day (at mid-day and quitting time) with a high pressure stream of water or, (2) dislodging the mortar droppings and projections with a pole or rod as the work progresses. After the lay-up of the wall is completed, remove the sand cover and mortar debris at the bottom of the grout space. The surface of the foundation should be left with clean aggregate exposed in the concrete matrix.

8. Wall Bracing. After construction of the masonry walls and prior to grouting, the walls should be adequately braced against lateral forces and other construction hazards until permanent supports are in place.
9. Grout Pours. In the High Lift Grouting Method, intermediate horizontal construction joints are not permitted. Plan the work for one continuous pour of grout to the top of the wall in four foot layers or lifts in the same working day. Should a blow-out, a breakdown in equipment, or any other emergency stop the grouting operation, an alternate procedure may be used with the approval of the architect or structural engineer and DSA. The total length of wall to be grouted in any one pour is limited to the number of sections between vertical control barriers in which each lift can be placed within one hour of the preceding lift. To prevent "blow-outs," no grout should be poured unless the mortar of the brick work has been allowed to set a minimum of three days in hot weather or five days in cold, damp weather. After all droppings and foreign material have been removed from the grout space (see Item 4 (7.) above), close the cleanout holes (see Item 4 (3.) above).

All reinforcing, bolts and embedded connection items should be rigidly held in position before grouting is started.

In order to control the rate of absorption of the brick units at the time of grouting, pre-wet the interior surfaces of the brick wythes prior to the start of the grout pour. Soak the bricks thoroughly with water the evening prior to the start of the grouting. In the case of hot, dry weather conditions it may be necessary to provide additional moistening of the grout contact surface of the brick the day of the pour.

10. Grouting Procedure. Handle the grout from the mixer to the point of deposit in the grout space as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry unit surfaces not being immediately encased in the grout lift. Discard the grout not in place within 1½ hours after water is first added to the batch.

Depending upon weather conditions and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Under normal weather conditions with typical masonry units, the individual lifts of grout are limited to four feet (4') in height with a waiting period between lifts of 30 to 60 minutes.

Place the first lift of grout to a uniform height within the pour section and vibrate thoroughly to fill all voids. This first vibration should follow immediately behind the pouring of the grout by not more than ten feet (10'). For vibration or consolidation, use an approved mechanical vibrator.

After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift should be poured and vibrated twelve to eighteen

inches (12"–18") into the preceding lift. This reconsolidates the preceding lift and closes any plastic shrinkage cracks or separations from the masonry units.

If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding lift, each lift is to be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. Repeat the waiting, pouring and reconsolidation steps until the top of the pour is reached. Reconsolidate the top lift after the required waiting period so that any space left by settlement shrinkage is filled with grout.

11. Curing. Attention should be given to proper curing of the mortar joints as well as the grout concrete pour. The brick masonry work and top of the grout pour should be kept damp to prevent too rapid drying during hot or drying weather, and drying winds.
12. Cleaning Wall. Soon after the grout work is completed, all exposed brick faces showing grout spotting should be washed down thoroughly with a pressure stream of water through a jet nozzle. Subsequent cleaning may be necessary as the curing is taking place and before final acceptance, and as directed by the architect.

5. Inspection and Core Tests.

5.1 Inspection. All masonry work is required to be continuously inspected during laying and grouting by an inspector specially approved for that purpose by DSA. The inspector makes test samples and performs such tests as are required by Item 4 (5.) above.

The special masonry inspector checks the materials, details of construction and construction procedure. He will furnish a verified report stating that of his own personal knowledge, the work covered by the report has been performed and materials used and installed in accordance with and in conformity to, the duly approved plans and specifications.

5.2 Core Tests. Take core tests of the completed masonry construction in accordance with CBC, Section 2105A.3.1.